The Advantages of FCC Modular Approval and How to Use it

Presented by Thomas T. Smith

Manager EMC Test Services

Presentation Overview

Modules provide a quick and easy method to take your product wireless or does it?

The focus of this presentation is to:

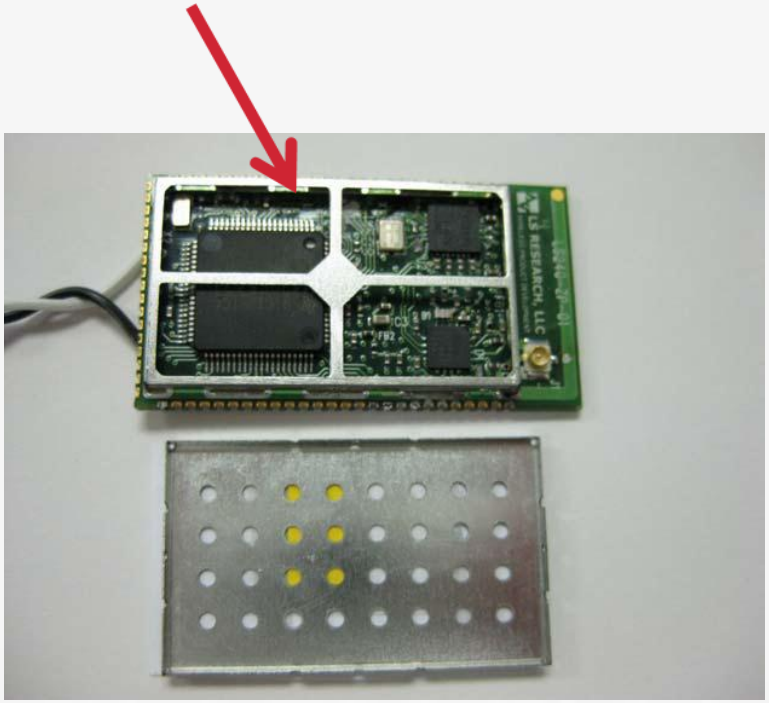
- **Briefly discuss what is considered a module**
- **How to determine if an FCC Modular Certification exists**
- **Discuss key items regarding the FCC Modular Certification**
- **What if you want to make changes to the certified module**

What is a module?

- **Types of modular approvals: single, split and limited**
- **Single modular transmitters consist of a completely self-contained radiofrequency transmitter device that is typically incorporated into another product, host or device**
- **Advantages of the Modular approval**
  - Potentially No Additional RF testing is required (only unintentional emissions with the radio inside of your product)
  - Quicker time to market as design and certification process is complete
  - Minimal RF/Wireless expertise required if your modular partner is responsive
- **There are 8 key requirements that need to be met in order for a single modular approval to be allowed**
- **The 8 key requirements can be found in CFR Title 47 Part 15.212 (a)(1)**

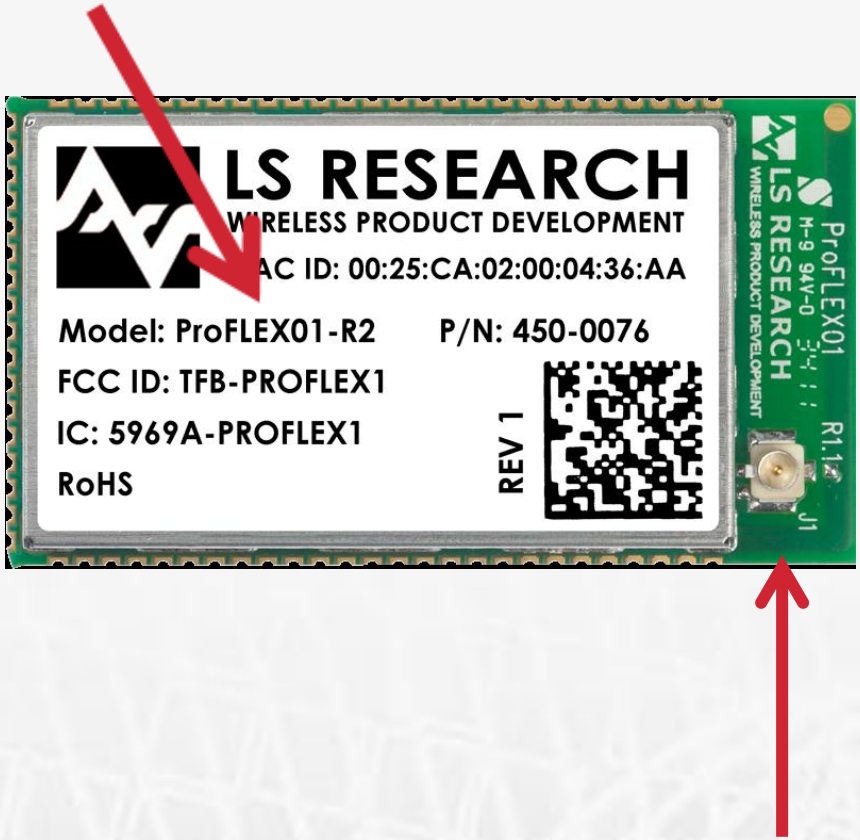
Abbreviated list of the 8 Points

- The radio elements of the module requires a RF Shield
- Module is to have buffered modulation/data inputs (need to ensure no excessive data rates or over-modulation
- Power Supply regulation on the module



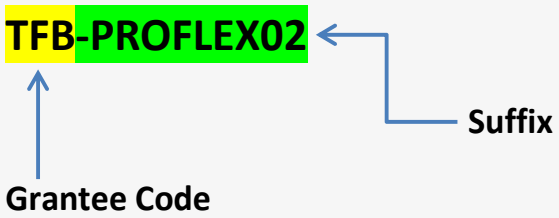
Abbreviated list of the 8 Points

- Meet the antenna requirements as discussed in 15.203, 15.204(b) and 15.204(c).
- Tested in a Standalone configuration
- Permanently affixed label
- Module must comply with any other requirements the other complete radio transmitters
- Module must comply with any RF Exposure requirements as outlined in 2.1091 and 2.1093



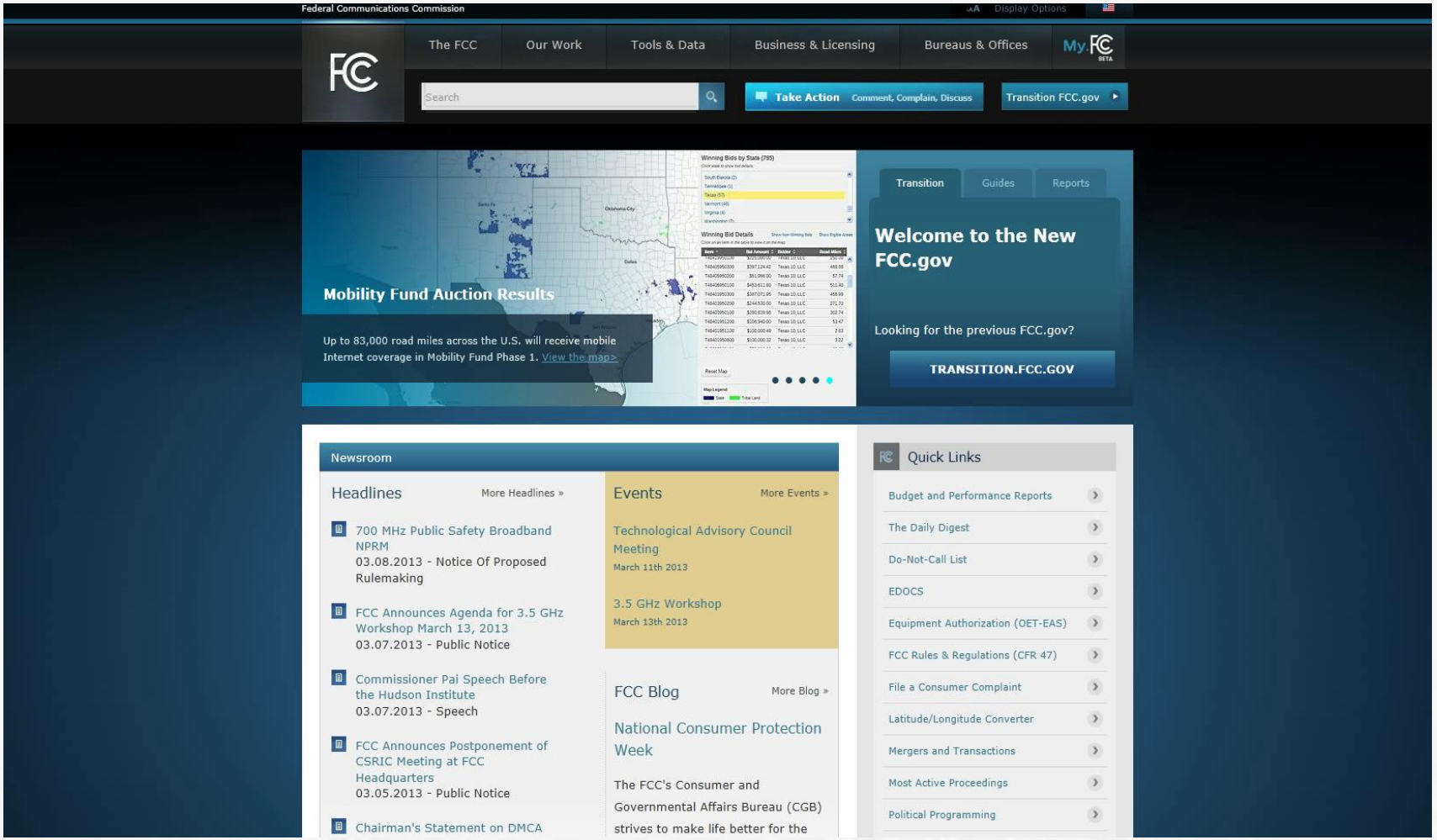
FCC ID Number

- The FCC ID Number is a unique identifier for each radio product that has been certified.
- The FCC ID Number is composed of a prefix and a suffix.
- The prefix is also referred to as the Grantee Code
- The suffix is chosen by the end customer



- Per the requirements for modular approval. The FCC ID number should be found on the module.

How to find the Grant of Authorization

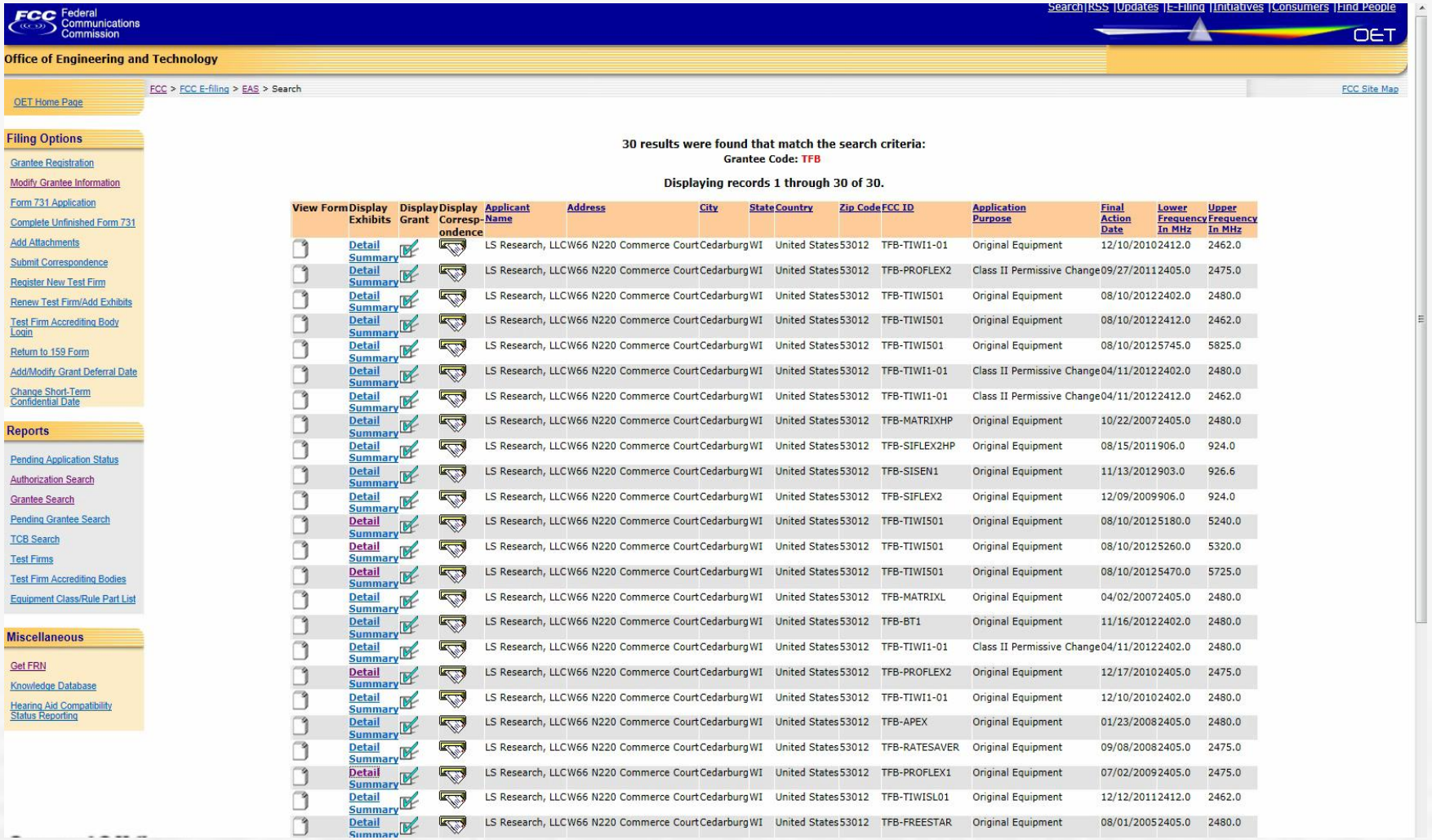


Submitted Documents

- **Items Typically Not under confidentiality**
  - User Manual
  - Labels
  - External Photos
  - Internal Photos
  - Test Setup Photos
  - Test Report
  - MPE/SAR evaluation

- **Items Typically Held under confidentiality**
  - Block Diagram
  - Schematics
  - Theory of Operation

How to View Submitted Documents



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Office of Engineering and Technology

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Miscellaneous

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- Knowledge Database
- Hearing Aid Compatibility Status Reporting

30 results were found that match the search criteria:
Grantee Code: TFB

Displaying records 1 through 30 of 30.

View Form	Display Exhibits	Display Grant	Display Correspondence	Applicant Name	Address	City	State	Country	Zip Code	FCC ID	Application Purpose	Final Action Date	Lower Frequency In MHz	Upper Frequency In MHz
	Detail Summary			LS Research, LLC	W66 N220 Commerce Court	Cedarburg	WI	United States	53012	TFB-TIWI1-01	Original Equipment	12/10/2010	2412.0	2462.0
	Detail Summary			LS Research, LLC	W66 N220 Commerce Court	Cedarburg	WI	United States	53012	TFB-PROFLEX2	Class II Permissive Change	09/27/2011	2405.0	2475.0
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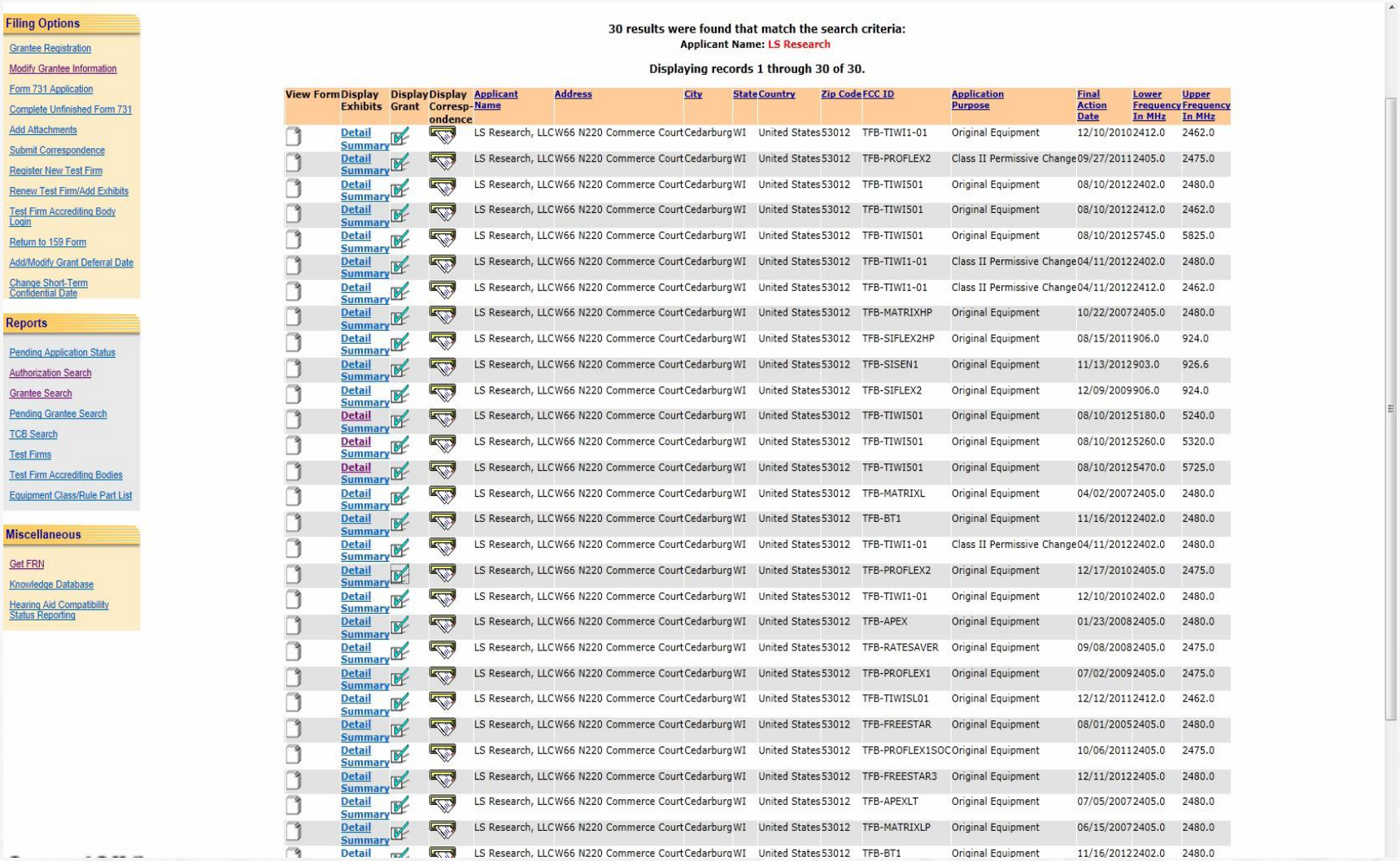

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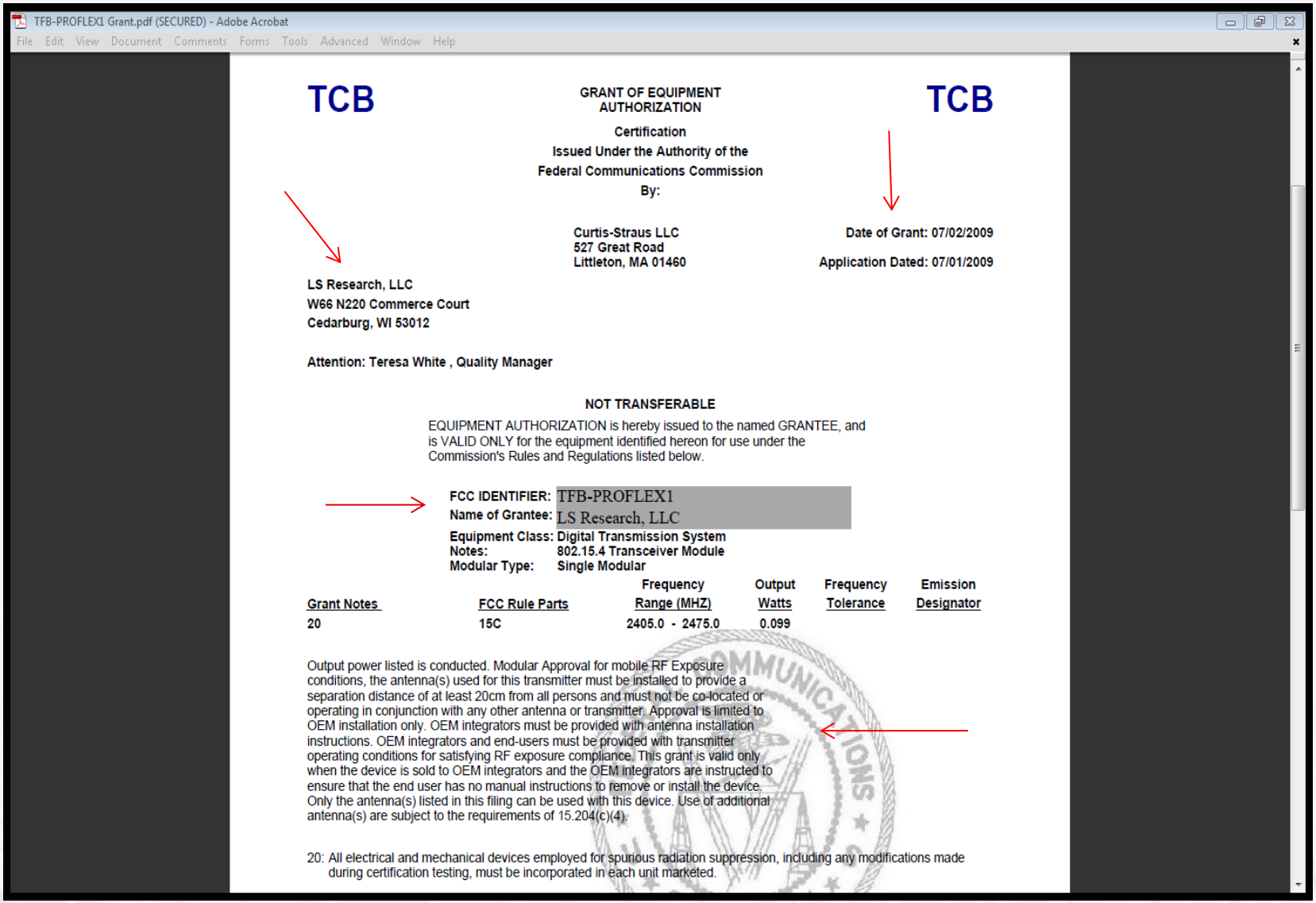
LS RESEARCH
WIRELESS PRODUCT DEVELOPMENT

What is on the Grant of Authorization



TFB-PROFLEX1 Grant.pdf (SECURED) - Adobe Acrobat

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TCB

GRANT OF EQUIPMENT AUTHORIZATION

Certification

Issued Under the Authority of the

Federal Communications Commission

By:

TCB

Curtis-Straus LLC
527 Great Road
Littleton, MA 01460

Date of Grant: 07/02/2009

Application Dated: 07/01/2009

LS Research, LLC
W66 N220 Commerce Court
Cedarburg, WI 53012

Attention: Teresa White , Quality Manager

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: TFB-PROFLEX1
Name of Grantee: LS Research, LLC
Equipment Class: Digital Transmission System
Notes: 802.15.4 Transceiver Module
Modular Type: Single Modular

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
20	15C	2405.0 - 2475.0	0.099		

Output power listed is conducted. Modular Approval for mobile RF Exposure conditions, the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. Approval is limited to OEM installation only. OEM integrators must be provided with antenna installation instructions. OEM integrators and end-users must be provided with transmitter operating conditions for satisfying RF exposure compliance. This grant is valid only when the device is sold to OEM integrators and the OEM integrators are instructed to ensure that the end user has no manual instructions to remove or install the device. Only the antenna(s) listed in this filing can be used with this device. Use of additional antenna(s) are subject to the requirements of 15.204(c)(4).

20: All electrical and mechanical devices employed for spurious radiation suppression, including any modifications made during certification testing, must be incorporated in each unit marketed.

Portable Devices

- **Portable devices are defined as transmitting devices designated to be used so that the radiating structure(s) of the device is/are within 20cm of the body of the user**
- **Examples:**

Specific Absorption Rate (SAR)

- **SAR is a measure of the amount of radio frequency energy absorbed by the body.**
- **Guidelines on SAR limits and general examples can be found in OET Bulletin 65 and Supplement C**

Exposure Category	Low Threshold
General Population	$(60/f_{GHz})$ mW, d < 2.5cm $(120/f_{GHz})$ mW, d ≥ 2.5cm

- **Example Calculations:**

1. 915MHz : 65.6mW = 18.2dBm d<2.5cm
   :131.1mW = 21.2dBm 2.5cm<d<20cm
2. 2440MHz :24.6mW = 13.9dBm d<2.5cm
   :49.2mW = 16.9dBm 2.5cm<d<20cm

SAR Limits

FCC LIMITS FOR SPECIFIC ABSORPTION RATE (SAR)

(A) Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

(B) Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

NOTE 1: See Section 1 for discussion of exposure categories.

NOTE 2: ***Whole-Body SAR*** is averaged over the entire body, ***partial-body SAR*** is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube. ***SAR for hands, wrists, feet and ankles*** is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

NOTE 3: At frequencies above 6.0 GHz, SAR limits are not applicable and MPE limits for power density should be applied at 5 cm or more from the transmitting device.

Note 4: The time averaging criteria for field strength and power density do not apply to general population SAR limit of 47 CFR §2.1093.

Mobile Devices

- **Mobile devices are defined as transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20cm is normally maintained between the transmitters radiating structure and the body of the user or nearby persons.**
- **Examples:**

MPE Calculations

- **For devices that are used in mobile applications an MPE (Maximum Permissible Exposure calculation can be performed in place of an SAR evaluation.**

- **All MPE Calculations are performed at a 20cm separation distance**

$$S = \frac{PG}{4\pi R^2}$$

- S=Power Density
- P= Power Input to Antenna
- G= Power Gain of the antenna in the direction of interest relative to an isotropic radiator
- R=Distance to the center of radiation of the antenna

MPE Limits

FCC LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

(A) Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $|E|^2$, $|H|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	($900/f^2$)*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6

(B) Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $|E|^2$, $|H|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	($180/f^2$)*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

f = frequency in MHz *Plane-wave equivalent power density

NOTE 1: See Section 1 for discussion of exposure categories.

NOTE 2: THE AVERAGING TIME FOR GENERAL POPULATION/UNCONTROLLED EXPOSURE TO FIXED TRANSMITTERS IS NOT APPLICABLE FOR MOBILE AND PORTABLE TRANSMITTERS. SEE 47 CFR §§2.1091 AND 2.1093 ON SOURCE-BASED TIME-AVERAGING REQUIREMENTS FOR MOBILE AND PORTABLE TRANSMITTERS.

Reasons for Modifying the Grant of Authorization

- **Modifications can be made using the Permissive Change Policy as found in Part 2.1043 and KDB #178919**

- **Some reasons for a Permissive Change or potentially a new FCC ID Number are:**
  - Adding New Antenna
  - Using Module in a portable application
  - Co-Location or use with Multiple radios
  - Change of FCC ID

New Antennas

- **No additional testing or Class II permissive Change is required if:**
  1. The antenna is of same type and equal or lesser gain
  2. In addition the in-band and out-band characteristics of the antenna need to be similar

- **Reasons additional testing and modifications to the Grant would be required**
  - Violation of 1 and 2 above
    - Different type of antenna
    - Higher Gain
    - Change in cable length or material which creates lower loss
    - Change in layout of PCB trace antennas
  - Antenna connector change
    - **Not Allowed**: “N”-type, regular “SMA”, standard “BNC” and standard “F” Type
    - **Acceptable**: Reverse polarity “SMA”, u.Fl, MMCX

Violating Notes portions of the Grant of Authorization

- **Using radio that was certified for Mobile use in a portable configuration**
  - As discussed previously the Grant may not specifically indicate mobile or portable configuration, therefore OEM needs to evaluate the documents to determine proper classification
  - A module that was certified for mobile use can be used in a portable application if it is evaluated for compliance to the RF Exposure requirements.
    - Typically this would require SAR testing in the host.
    - The Grant of Authorization is then modified using the permissive change policies
    - Usually RF testing of the radio is not required as the procedure and limits for output power do not differ between mobile and portable.

Co-location

- Co-location refers to the use of 2 transmitting devices having radiating structures within 20cm of each other
- In addition to the separation distance between the transmitting antennas, one also needs to verify that both transmitters are capable of transmitting at the same time
- Co-location testing consists of having both Transmitters transmitting at the same time and then evaluating the spectrum for any inter-modulated harmonics or additive effects.
- The co-location testing is not limited to 2 radios operating in the same band (2.4GHz Bluetooth and 2.4GHz WiFi), but also in cases where the operating bands are separated (900MHz ISM radio and 2.4GHz Bluetooth)

Challenges of Leveraging Modular Certification

- **In many cases OEM's are using modules "off the shelf" or modules they do not own the Grant of Authorization**

- **As a result if OEM needs to make modifications to the Grant of Authorization it may not always be in their best interest to do a Permissive Change or the Permissive Change may not be possible.**
  - Test Software
  - Module manufacturer doesn't want to make any changes
  - Module manufacturer receives all the benefits

Change of FCC ID

- **One solution is to perform a Change of FCC ID**
  - Benefits:
    - This allows the OEM to have a unique FCC ID number for the module
    - No RF Testing is necessary unless modifications are made to the module
    - Prevents Module manufacturer from using new antennas or changes certified by the OEM
  - Additional Responsibilities:
    - Need Permission and signed letter from Module Manufacturer
    - Labeling
    - New User Manual
    - RF Testing may be required
    - Increased cost filing and possibly for testing
    - Need to track any changes made by the module manufacturer

Conclusion

- **Modular Approval can be a very powerful and effective method to take your product wireless**
- **However understanding the Grant of Authorization and how the product was originally certified is critical**
- **Modifications to the Grant of Authorization to allow for additional flexibility are possible, but they can be costly and affect the overall complexity of using a module**

Resources

- **DA 00-1407 Part 15 Unlicensed Modular Transmitter Approval**
  - List the 8 requirements to be compliant for Single Modular Approval
- **KDB #996369 D01 Module Certification Guide v01r03**
  - This document outlines modular certification guidelines
- **KDB #447498 D01 General RF Exposure Guidance v05**
  - This document discusses Mobile and Portable Device RF Exposure Procedures
- **KDB #447498 D02 SAR Procedures for Dongle Xmtr v02**
  - This document discusses SAR testing for dongles
- **KDB #178919 D01 Permissive Change Policy v05r03**
  - This document outlines permissive change policies for transmitting devices, including modules

Questions?

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